Running Water

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The *Running Water* poster uses the South Saskatchewan River Basin to explore the wide variety of water-related activities that occur in Alberta.

When we think of water we often think of drinking, bathing or cooking, but there is much more to know about Alberta's water system. Water plays an important role in Alberta's society, economy and environment. It is important for all of us to have an understanding of where water comes from, how we use it, and what we can do to protect it. This will help us ensure we have water for future generations. *Running Water* reminds us that all water is connected; fuelling our cities, towns and industries, while providing essential habitat and ecosystem functions. Following the flow can teach us how to be water stewards.

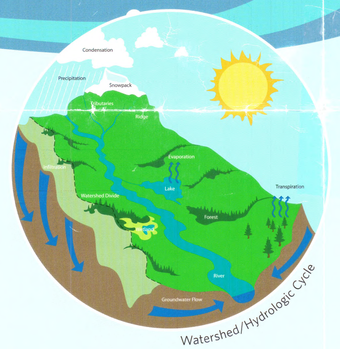
Inside education

Watersheds

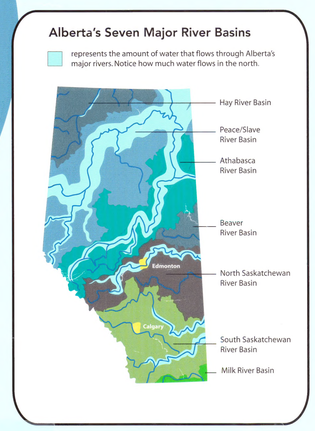
Everyone lives in a watershed.

A **watershed** is an area of land that drains into a body of water such as a stream, river, lake, wetland or ocean. Gravity causes water to flow into these locations, also known as catchments or basins. The geography of the region helps to shape the watershed.

Watersheds can vary in size, from the area surrounding a lake to a river basin that covers many provinces! For example, the *Little Bow Watershed* is part of the *Oldman River Basin* which is part of the **South Saskatchewan River Basin**. Alberta has seven major river basins, each named after the major river that flows through them.



Watershed/Hydrologic Cycle


Alberta's Seven Major River Basins
represents the amount of water that flows through Alberta's major rivers. Notice how much water flows in the north.
Hay River Basin
Peace/Slave River Basin
Athabasca River Basin
Beaver River Basin
Edmonton
North Saskatchewan River Basin
Calgary
South Saskatchewan River Basin
Milk River Basin

Water Quality

Water quality is a matter of perspective and we must consider what the water will be used for to determine its quality. For example, clear treated water may be considered high quality for drinking but is probably undesirable to the aquatic plants and animals that require the nutrients found in untreated water.

When measuring water quality we look at its chemical, physical and biological characteristics.

Chemical
- Nutrients - such as phosphorus and nitrogen
- Hardness - the concentration of magnesium and calcium in the water
- Dissolved oxygen - the amount of oxygen that is dissolved in the water

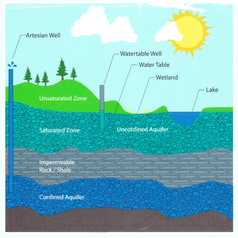
Physical
- Temperature - affects aquatic organisms and the biological and chemical composition of the water
- Turbidity - the clarity of the water
- Flow rate - how fast the water moves

Biological
- Animals - the variety and abundance of wildlife found in and around the water
- Plants and algae - plant growth can indicate nutrient concentrations
- Bacteria - some types of bacteria may be harmful to humans, livestock or wildlife

How much water do we use?

Water is essential; we need it to live. It also sustains our environment and our way of life. Humans use water for a wide variety of activities from industries like agriculture, petroleum and manufacturing, to municipal home and business use, as well as recreation.

If you take a look at the water in Alberta you will notice that most of it is located within the big rivers in the north, but the majority (approximately 80%) of Albertans, the major water users, live in the southern part of the province. Some people call this Alberta's **"water paradox"**.



Running beneath our feet

Groundwater is not typically found in large underground caverns or lakes as is commonly thought. It is located in the tiny pores and spaces of soil, sand and rock formations. These saturated areas of rock and sand are called **aquifers** and can be found all over the province at depths ranging from a few metres to several kilometres.

The amount of groundwater in Alberta is thought to be well over 1000 times greater than our surface water supply! Groundwater is naturally filtered and many people in rural areas rely on it for household use from wells. However, much of Alberta's groundwater is found much deeper and considered unsuitable for human consumption. As water trickles deeper and deeper, it is concentrated with minerals and becomes **harder** and more **saline** (salty). Since it is not potable, this saline water is increasingly used instead by industry.

Water and Petroleum

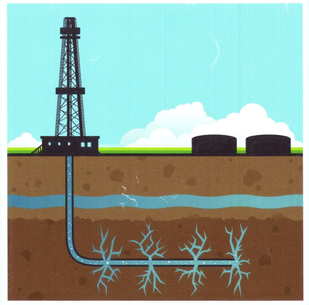
Alberta has a wealth of oil and gas resources, which not only fuel our cars and heat our homes, but also our economy. Much of Alberta's energy production relies on water. From enhanced oil recovery, hydraulic fracturing to oil sands, the relationship between energy and water is an important chapter in our water story.

Enhanced oil recovery

Oil does not usually come rushing out of the ground like you see in cartoons. There is also oil left in older wells that couldn't be recovered when they were first drilled. Oil and gas companies must use other methods to help get the remaining oil get to the surface. This process is called enhanced oil recovery (EOR) and it often involves water.

A common method of EOR is done by injecting water into an oil reservoir which causes an increase in pressure and forces the water and oil mixture to the surface, where the water is separated and reused. Another method of EOR is used to extract heavy oil that is too thick to pump and too deep to mine; in this case steam is injected into the deposit causing it to flow more easily and be pumped up to the surface.

The main concerns with EOR is that water is lost from the active hydrologic cycle. Petroleum companies aim to reduce their use of fresh water by using saline groundwater, increasing the amount they recycle and seeking alternatives e.g., using carbon dioxide gas (CO^2) instead of water (also removes CO^2, a greenhouse gas, from the atmosphere).



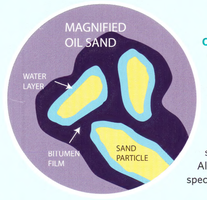
What is Hydraulic Fracturing?

Hydraulic fracturing is a process used in the petroleum industry in the extraction of oil and gas from rock formations with the pores SO tiny that normal drilling techniques will not work.

Hydraulic fracturing involves injecting a mixture of water (the 'hydraulic' part), sand and chemicals very deep underground (sometimes kilometres!) into the rock formation and literally cracking (fracturing) the rock. Doing this allows for the oil or gas to be freed from the tight rock pores and brought to the surface.

So why are people concerned? Mostly it has to do with water.

Concerns	Considerations
Fractured rock will cause natural gas to contaminate groundwater aquifers and drinking water.	Gas resources are thousands of metres below groundwater resources and under caprock.
Using water for industrial purposes, and removing it from the water cycle may not the best use of our water resources.	Industry is moving towards the use of saline water found deep underground. Most of the water that comes to the surface with the oil and gas is re-used.
The safe disposal of waste water and chemicals that are left over once hydraulic fracturing is finished.	Industry is required to follow strict guidelines for water disposal and management and report on the chemicals used in the fracking process.



Oil Sands

Oil sands refer to grains of sand that are coated with a thin layer of water and bitumen. Water is key to separating the bitumen from the sand, and is also required for production. If oil sand deposits are close to the surface they can be mined, but if they are deep underground, which they most often are, then in-situ methods are used.

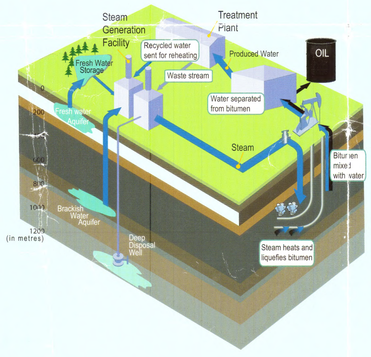
Mining

After the oil sands are mined they are mixed with hot water. This starts the separation process and allows them to be transported to the upgrader. By heating up the oil sands the bitumen slides off the sand and floats to the surface. At the upgrader more hot water along with solvents are used to fully separate the bitumen from the sand. All the leftover waste water, solvents, and silts from the upgrading process settle in tailings ponds. With time and special treatment the water in tailings ponds can be reused.

In Situ

Most of the oil sands in Alberta are recovered in-situ or in-place (meaning that they are not mined). **Steam Assisted Gravity Drainage (SAGD)** is the most common in-situ technology used today. Some say a SAGD facility is more like a water treatment plant than an oil production site because of the large of amount of on-site infrastructure that is specifically used in the water treatment process. Industry treats saline groundwater, turns it into steam, and uses it to heat the thick sticky bitumen so that it can flow to the surface. Once the condensed steam and bitumen are at the surface, the used water is then cleaned again and re-used.

Concerns about water use and the ecological integrity of our watersheds dominate conversations about oil sands. Industry, government, researchers and non-government organizations are continually working on ways to reduce the amount of water used in oil sands production, and to mitigate negative wildlife interactions. For example, 95% of the water used in SAGD operations is recycled, and companies are using air cannons, scarecrows, and lights to keep birds off of tailings ponds.



William C. Wonders Map Collection
University of Alberta Libraries

Water and Stewardship

Water for generations to come

There are many demands placed on Alberta's shared water resources. We must ensure that enough clean water is available for a healthy environment and a healthy population. To reach this goal, the government of Alberta manages its 7 major river basins, or watersheds, each of which are named after the main river that flows through the area.

Each watershed has a unique mix of stakeholders, such as agriculture, municipalities, industries and recreation, that rely on its water resources and can affect the quality and quantity of the water. Everyone lives in a watershed and therefore is responsible for the actions they take within their watershed. Together our actions and awareness can protect and conserve Alberta's unique watersheds for generations to come.

Water at home

Have you ever noticed that many of Alberta's towns and cities are located near a river or lake? This is not a coincidence. Water is a basic necessity of daily life and our municipal water supply refers to all the treated water that is used in our homes, businesses and local industries.

"Water" you doing?

Taking care of our watersheds is everyone's responsibility. Sustainable development and stewardship ensures we have enough high quality water for many generations.

There are a lot of great water stewardship organizations in Alberta that can help you take action in your watershed, for instance:

- Reduce stormwater pollution with Trout Unlimited'sYellow Fish Road program
- Participate in citizen science with Alberta Lake Management Society or NatureWatch
- Think globally with the Centre for Affordable Water and Sanitation Technology (CAWST)
- Become a wetland hero with Ducks Unlimited Canada
- Learn more with Inside Education!

Water and Environment

Climate Change

A combination of natural and human activities have increased the concentration of greenhouse gases (GHG's) in our atmosphere. This increase results in an over-efficient greenhouse effect and a rise in global temperatures, which contributes to climate change.

How could water be affected by climate change?
- Changes in precipitation patterns (wet areas get wetter, dry areas get drier and vice versa)
- Increased frequency and intensity of storms
- Decreases in the amount of snow accumulation
- Increases in evapotranspiration (moisture loss by plants) due to a longer growing season
- Increases in glacier melt and decreasing size of glaciers
- Changes in amount and timing of river flows
- increased water temperatures

As Alberta's population continues to increase, the demands on our water supply will also increase. Wise management, stewardship and conservation of our water resources is becoming increasingly important.

Species at Risk

Healthy watersheds are connected to healthy wildlife. Unfortunately, there are several Alberta species that are considered "at risk" and whose population is vulnerable. These species require special attention or management to help maintain and recover the population.

Each species at risk has unique challenges that conservation biologists are working to understand. Often population declines can be connected to habitat loss or changes, disease, exploitation, climatic changes or the introduction of an invasive species. Plants, invertebrates, amphibians, reptiles, birds, fish and mammals all need healthy watersheds.

Dave Prescott, ASRD

Beneficial Buffers - Riparian Areas

Riparian Areas are the zones surrounding a body of water that hold plants and grasses as well as trees and shrubs.

Wetlands are areas of land that hold water either temporarily or permanently; they are classified as peatlands or non-peatlands.

Riparian areas and wetlands, also thought of as buffer zones, are very important because they:
- Filter out pollutants
- Slow the flow of run-off from rain or snowmelt and absorb water, preventing floods
- Strengthen stream banks and shorelines
- Decrease erosion
- Provide habitat to a wide variety of plant and wildlife species

Riparian areas and wetlands are also used for recreational activities like hiking, fishing, hunting, camping and swimming. It is important to remember how fragile and important these ecosystems are. Next time you are relaxing by a lake or stream take care of the water AND riparian area by staying within trails and designated areas, packing out your garbage and respecting the plants and animals that call the area home.

Water and Agriculture

Managing the Flow

Water is one of the most valuable resources on Earth, yet its availability is not always predictable. Humans require a consistent water supply for our municipal, agricultural and industrial uses.
A **dam** is a barrier across a river or stream that holds back and regulates the river's flow. A **reservoir** is the body of water that forms behind the dam. Dams and reservoirs have been around for millennia and are quite common, with more than half of the world's rivers being dammed. However, there is controversy surrounding the construction and use of dams and reservoirs.

Irrigation

Water in Southern Alberta doesn't travel far before it enters a managed system where people control how, when and where the water flows. Because it is relatively dry, farmers require a reliable source of water. Irrigation systems have been developed to transport water from rivers to farmer's fields; these systems include large canals, pipelines reservoirs and sprinklers. Reservoirs resemble large lakes and are used to store spring rains and snowmelt and release the water during the warm, dry summers when rivers are at their lowest levels. The reservoirs are connected to a series of canals and pipelines that deliver water to farms so fields can be watered using large sprinklers often called 'pivots'. Reservoirs also provide water for a number of other uses. Many communities in southern Alberta have access to fresh water because of the irrigation systems. The dams that create reservoirs can be also be used for hydroelectric power generation, and if you've gone boating or swimming in southern Alberta 'lake', it was likely a reservoir!

So what's the concern?

One of the main concerns with irrigation agriculture is the vast amount of water it uses. These irrigation systems are the largest users of fresh water in Alberta, accounting for over 60% of all water consumed in the province (Alberta Water Portal, 2013). Though it is important to note that the water does not leave the water cycle. Finding new ways to irrigate using less water is a priority, and over the years there have been many improvements in irrigation agriculture techniques.

Opportunities	Challenges
Supplies water downstream when natural flows would normally be low.	Sediments can accumulate in the reservoir and reduce its capacity to hold water.
Creates storage reservoirs that provide water for irrigation and municipalities.	Natural fluctuations in stream flow are altered which may affect plant and animal life.
Can be used for hydroelectric power generation.	Creation of reservoir requires a large area to be flooded sometimes leading to the relocation of people and wildlife.
Recreational uses - reservoirs frequently used for swimming, boating, and fishing.	Dams and reservoirs require careful monitoring and maintenance.
Manages water during high flows to reduce the occurence of flooding downstream.	Results in changes to the ecosystem affecting everything from biodiversity to migration patterns.

Grazing and Livestock

Healthy livestock and thriving ranching communities rely on access to a high quality water supply. Livestock grazing near water bodies increase the risk of impacting the water quality through potential vegetation removal, soil disturbance or fecal contamination. Proper management of grazing, especially in sensitive areas like riparian areas, makes for healthier livestock and healthier watersheds.

Ways to improve pastures and ranges to protect watersheds:
- Minimize grazing of sensitive areas during prime growing seasons
- Rotate livestock to different pastures, providing 'rest time' for grazed areas to recover
- Use off-site watering systems to keep livestock away from water bodies
- Improve fencing of riparian areas